

The Resource

for Environmental Education in Missouri

December 2002 • Vol. 5 • No. 2



Wondrous winter

Winter – the double season. Beginning with the winter solstice on December 21, the shortest day of the year, winter marks the end of temperate weather, the long growing season of summer and fall harvest. By the time the vernal equinox rolls around in March, winter is giving way to the resurgence of growth and new life that comes with spring. In between the two, inhabitants of the natural world are challenged to survive. Plants and animals must contend with freezing temperatures and a scarcity of food and water. Meeting this challenge requires several tactics, namely adaptation.

For animals, adaptation includes hibernation, migration, or acclimatization. Ground hogs, badgers and bats hibernate. Squirrels, chipmunks and mice stash seeds in various hiding places to uncover during sporadic awakenings from their deep winter sleep. Bears and many other types of animals accumulate fat reserves to use for energy when food is scarce. Insect eating birds and water birds including ducks, herons and gulls migrate to where they can find appropriate food. Mammals like deer and fox acclimate by growing thicker coats of fur. Cardinals acclimate by changing their diet from insects to seeds. Most insects die, leaving eggs in hardened cases or protected areas that over-winter, hatching in the spring.

Plants also evoke survival strategies. Evergreen trees like pine and fir have thick sap which does not freeze. In addition, they possess strong, flexible branches capable of resisting breaking under the weight of snow. Deciduous trees become dormant, dropping their leaves and storing food, in the form of starch, in their roots. The root systems of perennial wildflowers and shrubs survive through the winter even when the above ground part of the plant has died. Annual wildflowers over-winter in the form of cold-resistant seeds.

Although this seems like a season of limited natural activity, nature is really never completely dormant. On close observation, a silent snow-blanketed or even barren winter landscape can reveal itself as the perfect setting for interesting and purposeful study of the plant and animal world. Take the opportunity this winter to get out and explore the marvels of nature in winter. As you do, be sure to adapt for the adventure by donning gloves, hats and warm coats and prepare a pot of hot chocolate for your return.

What's in it for you?



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Wintering Trees



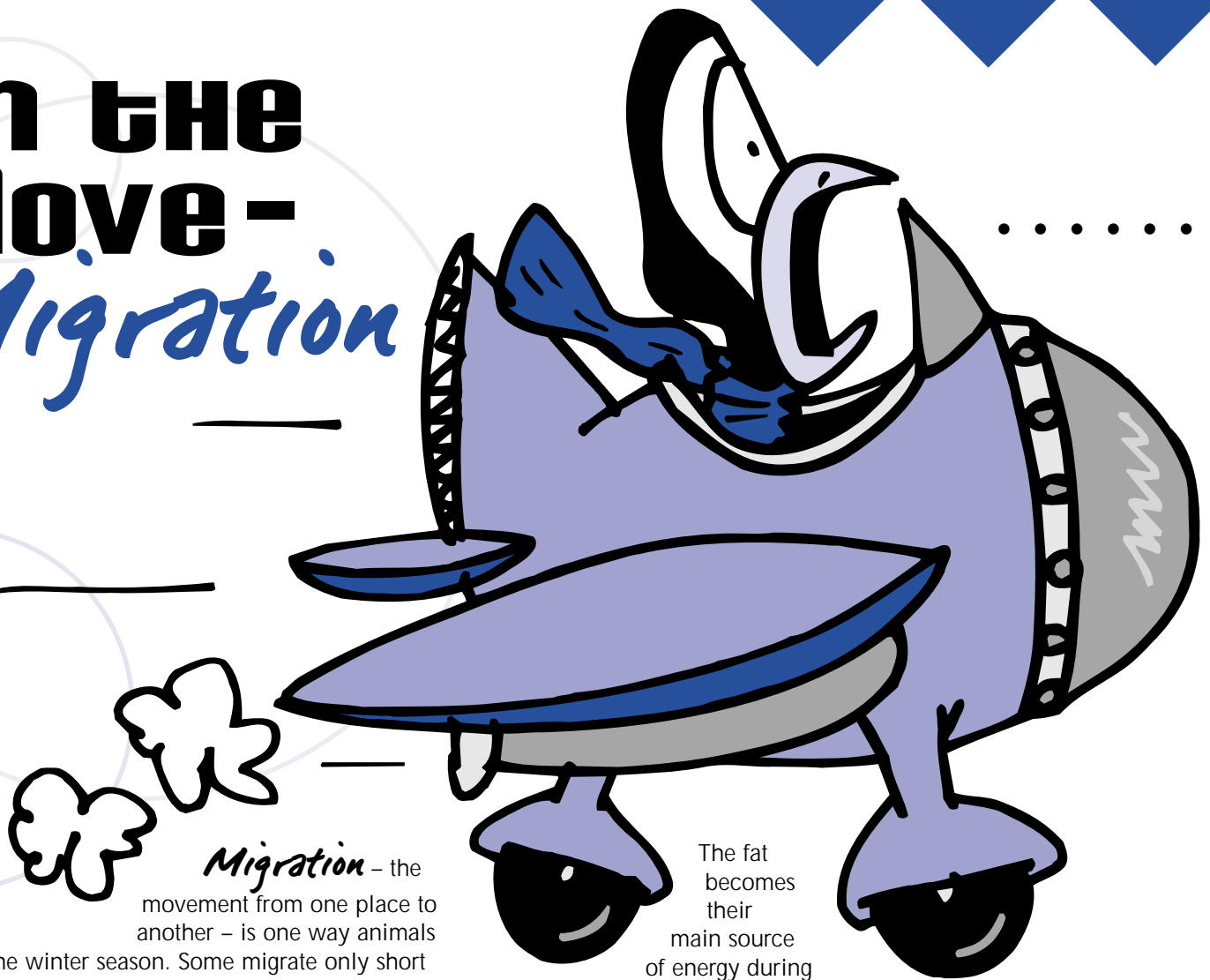
Project Resources page 7



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An entire issue devoted to
Winter Adaptations

On the Move - Migration



Migration – the movement from one place to another – is one way animals

adapt to the winter season. Some migrate only short distances, while others travel long distances. A true migrator makes a complete “round trip” each year, always returning to its original home. Most migrators travel from north to south. But a few, such as earthworms and termites, travel deeper into the ground to wait out the cold and then come back closer to the surface when warmer weather arrives.

Birds are the most common migrators. Using different cues to help them navigate, birds end up in the same place every year. Daytime migrants use the sun to point them in the right direction while nighttime migrants use the stars as a guide. Birds also rely on landmarks such as mountains, lakes and rivers, as well as the earth’s magnetic pull, to help them find their way. Most birds likely use a combination of these navigational tools to guide them in their yearly migrations.

Those that breed in North America and spend the winter south of the U.S. border are known as “neotropical migrants.” One of Missouri’s common summer residents, the Baltimore Oriole (*Icterus spurius*), is one of more than 300 kinds of neotropical migrants. Taking 2-3 weeks to prepare for migration, orioles must first molt their feathers and grow new ones. They feed voraciously, adding fat to their bodies.

The fat becomes their main source of energy during migration. Averaging 20

miles per hour, orioles can cover up to 150 miles nightly. Flying at night allows orioles to avoid predators such as hawks and generally they encounter less wind resistance than during the day.

Another Missouri summer resident, the Robin (*Turdus migratorius*) begins its preparation for migration in late summer and early fall by increasing its intake of fruit, insects and worms. Robins form large flocks for their journey south. Flying approximately 35 miles per hour, robins can cover 100-200 miles. Some fly all the way to southern Texas and Florida, but others winter as far north as they can find berries.

Shorter daylight hours and internal chemical changes signal Missouri’s smallest birds, the hummingbirds, that it is time to migrate. Despite what you may have heard, hummingbirds do not migrate on the backs of geese. They are capable of traveling astounding distances on their own. Experts believe many fly non-stop across the Gulf of Mexico at least once a year. Hummingbirds fly about 27 miles per hour, making the 500-mile trip across the Gulf 18-19 hours long.

Is it Hibernation or

Just a Deep Sleep?

Some animals hibernate for the winter, retreating into caves or burrows. Their body temperature lowers, breathing slows and they are difficult to awaken during their hibernation period.

Sleeping all winter takes preparation and animals that hibernate must start their preparations in the fall. They need to put on as much fat as possible because they won't be eating much during the winter. This special kind of fat, called brown fat, is found across the back and shoulders of the animals, close to the brain and liver. Brown fat works fast to deliver quick energy when coming out of hibernation.

There are different kinds of hibernation. The "true" hibernators sleep so deeply they are almost impossible to wake up. In Missouri, woodchucks, ground squirrels and bats are "true" hibernators. A woodchuck's heart rate goes from 80 - 95 beats a minute when active to 4 or 5 beats when hibernating. Its breathing may slow to only one breath every 5-6 minutes and its body temperature drops from 98° F to 38°F. Ground squirrels hibernate in a tunnel as much as 20 feet long well below the frost line. Carrying seeds in their cheek pouches, they fill food storage chambers throughout the tunnel. Some true hibernators get up every few weeks to nibble on food and relieve themselves. When bats are ready to

hibernate, they gather together in caves called hibernacula where temperatures stay above freezing.

Bears are not true hibernators. Considered "light" sleepers, they can be awakened easily and are simply taking long winter naps. Skunks, raccoons and opossums also fit into this category. These animals breathe a little more slowly and lower their body temperature a few degrees while sleeping, but their metabolism doesn't slow down nearly as much as a hibernator and they wake up to forage during mild winter weather.



Migration *Challenge*

Each fall Monarch butterflies migrate to Mexico. Trace a route from your area to the mountains just north of Mexico City. Then compute the distance a monarch flies during its migration.

Migration Distances

Long Distance Winter Travelers

Arctic Tern: longest distance by a bird and overall - 21,750 miles per year

Grey Whale: longest distance by a mammal - 12,500 miles

Monarch Butterfly: longest distance by a butterfly - 2,000 miles

Desert Locust: longest distance by an insect - 2,800 miles

Caribou: longest distance by a land animal - 700 miles

Freezing Frogs

Freezing temperatures present a challenge for cold-blooded terrestrial animals. Lacking the metabolic capacity to raise their body temperatures, most cold-blooded animals hibernate in cold seasons. That usually means going deep into the ground, below the frost line, or into the mud at the bottom of a pond. Some species of frogs use a different strategy. The Wood Frog, (*Rana sylvatica*), Gray Treefrog, (*Hyla versicolor*), and Spring Peeper (*Pseudacris crucifer*) have a tolerance to freezing.

As its body temperature falls, the frog becomes immobile. Actual freezing of some tissue, usually in the toes because of their high surface-to-mass ratio, triggers the protective response. As soon as the first freezing occurs, glycogen in the frog's liver is converted to glucose that is rapidly transported throughout the body. Within 10-15 minutes after its toes start to freeze, the frog has dispersed glucose throughout its body. Wood Frogs and Spring Peepers use

glucose as antifreeze, whereas Gray Treefrogs use glycerol. The "antifreeze" protects and stabilizes cellular function and structure by preventing intracellular freezing and dehydration.

Complete freezing takes about 24 hours for an adult wood frog. A frozen frog is stiff and white, the eyes opaque and more than half the water in its body has turned to ice. Respiratory movements, circulation and heartbeat have stopped. The frog can remain in this state for 1-2 weeks. Recovery occurs if freezing has not been too prolonged or deep and if ice crystal formation is confined to extracellular fluids.

Freeze tolerance is an adaptation that allows animals to be active in early spring and late fall when cold and warm periods alternate. During prolonged cold, even freeze-resistant frogs must retreat below the frost line.

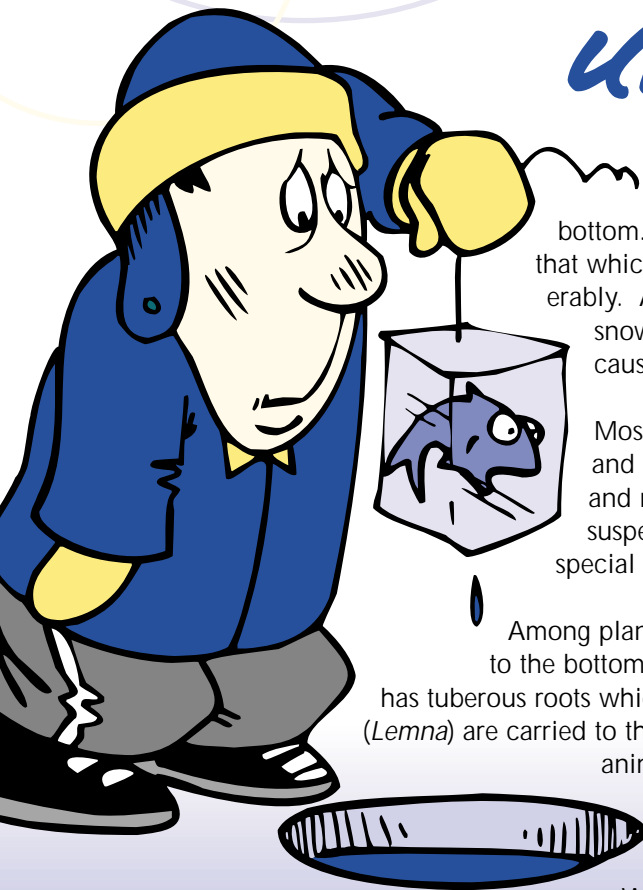
Underwater Winter

With the arrival of winter the surface of many ponds freezes over. The world underneath that ice becomes cold, but stable. Temperatures no longer fluctuate; they remain about 32° F right under the ice to 39° F at the pond bottom. There are no longer currents of water and the input of oxygen is limited to that which might enter via a stream or spring. Underwater life slows down considerably. An additional hazard to life in the water is introduced when a blanket of snow covers the ice, cutting out all light, stopping photosynthesis and sometimes causing winter kill.

Most aquatic organisms have a very narrow tolerance to changes in temperature and therefore must enact some type of adaptation for survival. Fish, salamanders and most reptiles adapt by temporarily reducing metabolism, which results in a suspended state of animation. Some plants and animals adjust by developing a special hibernating or aestivating phase or form.

Among plants, Coontail (*Ceratophyllum*) produces winter buds which break off and drop to the bottom to await the sprouting conditions of spring. Arrowhead (*Sagittaria latifolia*) has tuberous roots which become buried in the mud of the bottom. Young plants of duckweed (*Lemna*) are carried to the bottom with the decay of older plants to which they are attached. Among animals, various devices are common: winter eggs of the water fleas; the gemmules of sponges; statoblasts of bryozoans; and the cysts of many protists, copepods and annelids.

Warm-blooded aquatic species such as beaver and muskrat spend the winter in their half-submerged lodges. When leaving the lodge through an underwater tunnel to forage for food, these animals face the problem of massive heat loss, or hypothermia. Mammals cannot tolerate more than a slight level of hypothermia. They counter this type of heat loss with a number of behavioral and physiological adaptations. Their fur has superior insulative quality and they groom continually to help waterproof it with oils. These mammals can spend up to 40 minutes in the chilly water. When they return to their communal lodges, they find much warmer temperatures and commence to grooming with their nest-mates in a communal manner that helps them rewarm greatly.

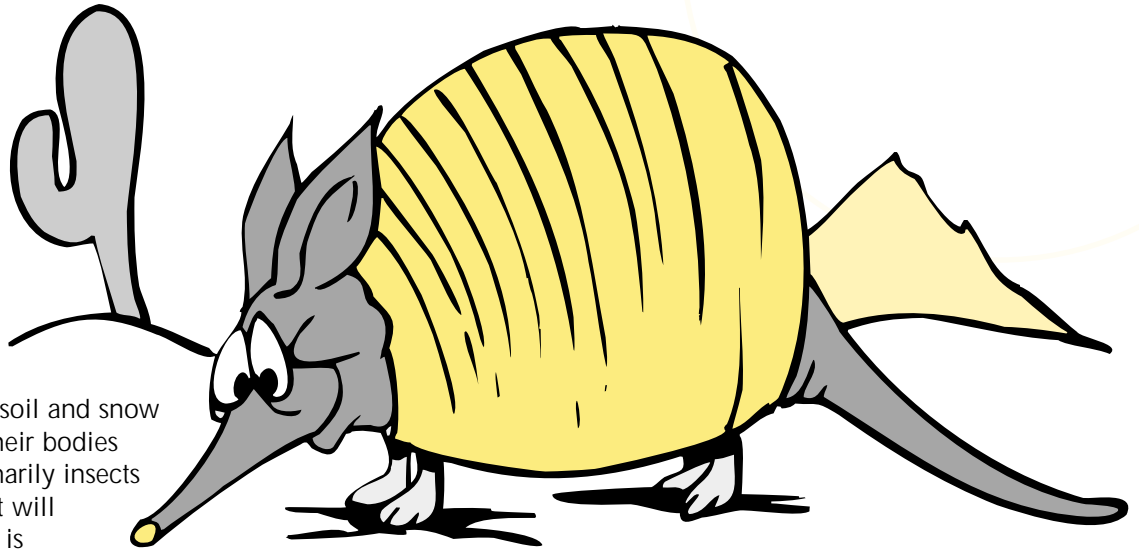


Advancing Armadillos

In the past few months the local TV news has reported several sightings of armadillos in Missouri. People from the Missouri Department of Transportation, as well as some private citizens, have reported finding the bodies of armadillos on our highways. However, few people have reported seeing a live armadillo in the state.

Of over 20 species of armadillo, only the nine-banded armadillo (*Dasypus novemcinctus*) lives in the U.S. Armadillos are nocturnal animals, rarely seen in daylight. They are not native to Missouri and not well adapted to the State's winter climate. Many scientists in the past have said the armadillos' northward migration would be stopped by the cold weather and they would never be seen north of Texas because armadillos cannot tolerate even short periods of extreme cold. They do not have large fat reserves to help insulate their bodies. Logically, armadillos should be unable to adapt to the cold winter weather in the central and northern US. However it appears that the armadillo is surprising everyone!

Armadillos are strange looking animals with long noses and short, strong legs well suited for digging. They dig burrows that range from 2 inches to 12 feet deep and can be up to 25 feet long. Armadillos build large nests of grass or leaves inside their burrows. Even though their bodies may not be able to tolerate the cold for very long, living so far beneath the soil and snow can give them the insulation their bodies cannot provide. They eat primarily insects – mostly beetles and ants – but will adapt to whatever food source is available. If an area has a small insect



population but large amounts of berries or other plants, the armadillo will adapt to a more vegetarian diet. They have also been known to kill and eat young rabbits and dine on scraps of carrion.

Armadillos require a constant source of water. Experts have indicated that armadillos can survive in areas that receive at least 15 inches of precipitation every year. Since Missouri's driest year in the last century yielded 25 inches of precipitation, we can speculate that the armadillo population in Missouri is here to stay!

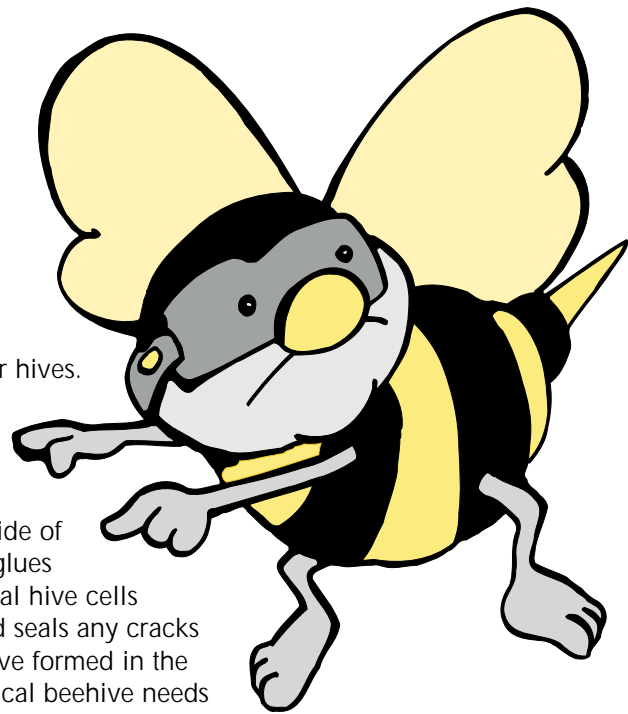
Did yOu Know???

Most animals don't eat moss. It's hard to digest and has little nutritional value. So why are reindeer wild about moss? The moss contains a special chemical that helps reindeer keep their body fluids warm. When the reindeer make their yearly journey across the icy Arctic region, the chemical keeps them from freezing—much as antifreeze keeps a car from freezing up in winter.

Brrr Bees

One would not expect a cold-blooded insect like the honeybee (*Apis mellifera*) to survive the frigid temperatures of winter. Being the industrious workers they are, bees have adapted a behavior that enables them to stay active by maintaining a constant temperature within their hive. The temperature in the hive rarely drops below 62°F even if outside temperatures drop as low as 20°F below zero. How do they keep the temperature constant? Some worker bees form a tight ring around the queen bee. The worker bees use stored honey as fuel and shiver to generate heat. Other bees form a ring around the heat-producing bees to keep the heat from escaping. As the inside bees continually flap their wings and shiver, they get tired and trade places with the bees in the outer ring. The bees continue to alternate their role as heat producer and heat retainer. In addition, throughout the year the honeybees use propolis, a sticky substance made up of plant resins and other substances

mixed together by the bees, to “caulk” their hives. They spread the propolis all over the inside of the hive. It glues the individual hive cells together and seals any cracks that may have formed in the hive. A typical beehive needs 60-70 pounds of honey to get the bees through the winter.



Wintering Trees

To plants winter becomes a time of drought. Most water is frozen in the ground or above it in snow and therefore unavailable to them. Lasting up to six months, this drought is a serious condition to which plants must adapt. Deciduous trees, such as oaks, maples and hickories adapt by losing their leaves in the fall and going dormant, surviving off of stored energy until spring returns. Evergreen trees, such as pines, spruce and firs have other adaptations for winter survival.

One adaptation is found in their leaves (needles), which are covered with a thick, waxy coating that helps hold in water and prevents evaporation. The leaves of some evergreens contain a kind of natural antifreeze that helps prevent injury to their water-filled cells. Because their leaves are so narrow, evergreens can survive harsh winter winds without losing their leaves all at once. Instead they do it gradually. Each year they produce some new leaves and drop the oldest ones. Most evergreen leaves stay on from 2-4 years before dropping. Because they keep their leaves year round, they can begin the photosynthesis process as soon as the days get longer and the temperatures warm in the spring.

Did YOU Know?

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Dormancy in Northern Hemisphere plants is caused by chemical changes within plant cells stimulated by cooling temperatures and shorter days in late summer and fall. This chemical change “binds” water so it cannot freeze and injure plant cells. To break dormancy, plants must first go through a period of cold (about 40°F or colder) for an average of 63 days. This cold period triggers changes which, when warm weather appears, allow plants to “deharden” and resume growth.

Project Resource Guide - Adaptations

Here's an array of activities about adaptations. Selected from Projects WILD, Learning Tree, and WET these interdisciplinary, hands-on, easy to use activities will get your students engaged in adaptations. To receive these outstanding education materials, along with their Standards correlations, attend the next training workshop near you. Contact the coordinators listed for more information.

Project WILD

Adaptation Artistry – Page 114, 2001 Edition Page 131 – Use art to identify and describe the advantages and importance of bird adaptations. (Grades 4-9)

Quick Frozen Critters – Page 122 – Describe the importance of adaptations in predator/prey relationships and describe how these relationships effect wildlife populations. (Grades 4-8)

Seeing Is Believing – Page 116, 2001 edition Page 114 – Explore vision as it relates to animal adaptations. (Grades K-6)

Surprise Terrarium – Page 118 – Examine camouflage as an example of adaptation and how it is used by animals. (Grades K-4)

The Thicket Game – Page 112, 2001 Edition Page 120 – An active discovery of the importance of behavioral adaptations to animals. (Grades Pre-K-6)

Who Fits Here – Page 160, 2001 Edition Page 64 – Describe how adaptations are related to specific ecosystems. (Grades 5-9)



Aquatic WILD

Marsh Munches – Page 58, 2001 Edition Page 34 – Identify the interconnectedness of a food web in a salt marsh. (Grades K-6)

Mermaids and Manatees – Page 44, 2001 Edition Page 80 – Distinguish between mythical and actual aquatic wildlife and deduct how imaginary creatures may be inspired by actual animals. (Grades 4-12)

Project Learning Tree

Birds & Worms – Page 77 – Become birds in a relay race and search for colored worms while discovering the advantages of protective coloration and its relation to survival. (Grades K-6)

Can It Be Real? – Page 30 – Unearth extraordinary plants and animals and gain insight on how they are uniquely adapted to environmental conditions. (Grades 4-8)

Charting Diversity – Page 27 – Examine how plant and animal adaptations increase biological diversity. (Grades 4-8)

Dynamic Duos – Page 79 – Symbiosis increases survival by providing relationships between organisms that aid in protection, transportation, food and shelter. (Grades 5-8)

For more information on Project WILD and Learning Tree workshops and materials, contact Bruce Palmer, State Coordinator, Missouri Department of Conservation, PO Box 180, Jefferson City, MO 65102-0180, 573/751-4115 extension 3113, <palmeb@mdc.state.mo.us>



Project WET

A House of Seasons – Page 155 – Construct a "House of Seasons" collage, to observe the role of water in each of the seasons. (Lower Elementary)

For more information on Project WET workshops and materials, contact Joe Pitts, State Coordinator, Department of Natural Resources, PO Box 176, Jefferson City, MO 65102, 1-800/361-4827, <nrpittj@mail.dnr.state.mo.us>



The Library

Conservation and Environmental Education Resources



Web Resources

Journey North

<http://www.learner.org/jnorth/index.html>

A website that engages students in a global study of wildlife migration and seasonal change.

Teachervision.com

<http://www.teachervision.com/lesson-plans/lesson-6989.html>

An entire unit containing lessons and activities to teach students about the different ways in which animals adapt to their environment. The lessons are appropriate for grades K-8.

Enchanted Learning

<http://www.enchantedlearning.com>

Has printouts of and information about a number of animals that hibernate and migrate in the winter.

Scholastic- Dirtmeister's Science Reporters

<http://teacher.scholastic.com/dirtrep/animal/>

Scholastic's website of teacher resources has this activity on animal adaptations. Suitable for grades 3-5, but can be adapted for lower or higher level students.

Animal Adaptations

http://www.uen.org/utahlink/activities/view_activity.cgi?activity_id=4750

Lists a number of questions about various animals and gives website links to research the answers to the questions.

Science NetLinks

<http://www.sciencenetlinks.com/lessons.cfm?BenchmarkID=5&DocID=232>

A lesson on animal adaptations to expand students' knowledge of animal features and behaviors that can help or hinder their survival in a particular habitat. Has a reproducible worksheet on animal adaptations. Suitable for grades 3-5.

Publications

Clever Camouflagers

Fredericks. These twelve creatures from around the world are some of Nature's all-time great hide-and-seek players. But it's not a game for them. It's a matter of survival. If they don't blend into their surroundings, they don't eat. Or worse yet, they'll be eaten. Readers will learn all about fish that look like seaweed, birds that turn white in the winter, plants that look like stones! Includes great up-close photos, detailed illustrations and habitat range maps. Ages 8-12. www.amazon.com (\$6.95)

Animals in the Fall (Preparing for Winter)

Saunders-Smith. Simple text and photographs present the behavior changes of animals as winter approaches, such as growing thicker fur, migrating and hibernating. Ages 4-8.

www.capstone-press.com/pebble.cfm (\$10.95)

The following publications are available from Acorn Publications, PO Box 2423, Tustin, CA 92781-2423 or 800/422-8886, <http://acornnaturalists.com>

They Walk the Earth

Simon. Descriptions of caribou, polar bears, lemmings, elephants, wolves, and nomadic people such as Lapps and Bedouins – all sharing one thing in common – they follow the seasons with their feet. Ages 8-14. #B-9128. (\$16.95)

A Guide to Nature in Winter

Stokes. This superb field guide to the winter season leads you to all of the exciting things you can discover in the “dead” of winter! Fascinating discussions of bird behavior in the winter, animal tracks, winter weeds and mushrooms, evergreen and deciduous plant survival strategies and more. #FG-3221 (\$13.45)

Life in the Cold, An Introduction to Winter Ecology.

Marchand. Over 300 pages of thoroughly researched and illustrated information on hibernation, characteristics of snowpacks, acclimation of plants to cold and winter drought, evergreen adaptations and advantages, the basics of energy exchange in animals, responses of cold-blooded animals, life under the ice, coevolution of plants and browsers, and animal adaptation to cold. #B-5042. (\$22.95)

Who Lives in the Snow?

Jones, Powell. New book on the remarkable creatures who survive and often flourish in and under the winter snow. Follow spiders as they search out springtails, and shrews as they track down spiders and beetles. Follow mice as they locate their seed larders, and fox as they listen for their sounds. Ages 4-10. #B-9918 (\$15.95)

Videos

Nature's Great Events

Reader's Digest. Set of three one-hour videos offers a breathtaking introduction to animal behavior and adaptation. A truly amazing, absolutely spellbinding introduction to the animal kingdom. Ages 8-adult. Acorn Naturalists #V-10290. (\$24.95.)

Media Loan

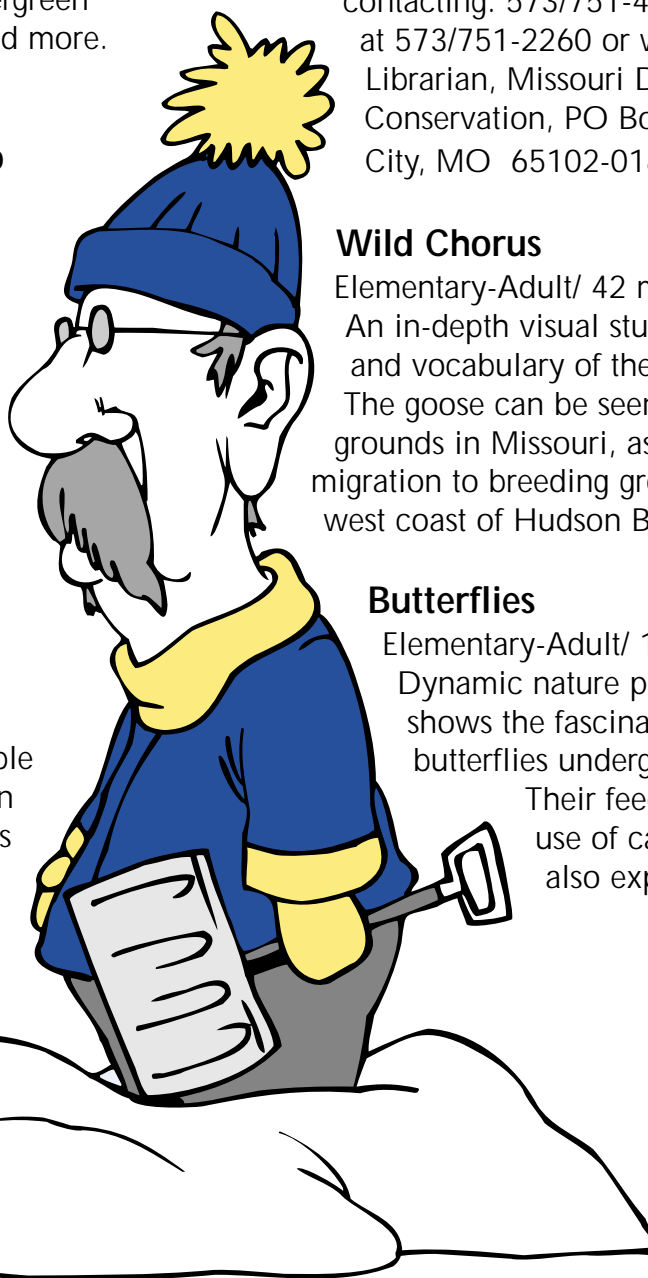
You may borrow the following items by contacting: 573/751-4115 x3837, fax at 573/751-2260 or writing to: Media Librarian, Missouri Department of Conservation, PO Box 180, Jefferson City, MO 65102-0180.

Wild Chorus

Elementary-Adult/ 42 minute video
An in-depth visual study of the motion and vocabulary of the Canada goose. The goose can be seen on its wintering grounds in Missouri, as well as in its migration to breeding grounds on the west coast of Hudson Bay.

Butterflies

Elementary-Adult/ 10 minute video
Dynamic nature photography shows the fascinating changes butterflies undergo in a life cycle. Their feeding habits and use of camouflage are also explored.



EE Calendar

Check It Out

Look in the education section of www.conservation.state.mo.us for up-to-date information on the Department of Conservation's educator workshops. There's something for everyone.

Education Certification Program to help educators develop in their students an appreciation for the history, management, and future of Missouri's fish, forest, and wildlife.

Participants will receive the Leopold Education Project Activity Guide with Show-Me Standards/MAP Descriptor correlations as well as hunter education certification.
Contact: Regina Knauer, MDC, 417/895-6880.

Now – January 5, 2003

The ENDURANCE

Discovery Center, Springfield
A stunning interactive experience featuring 150 haunting photographs, rare color images, film and multi-media that highlights Shackleton's legendary Antarctic expedition and the triumph of human spirit over adversity.

Admission \$7.00 adult, \$6.00 senior, \$5.00 children 3-12.
Contact: 417/862-9910 or www.discoverycenter.org.

December 13 – 14

Conservation and the Land Ethic in Missouri

Andy Dalton Shooting Range and Training Center, Bois D' Arc CA

Fee: Credit - \$128; Noncredit - \$95

This workshop combines the Aldo Leopold Education Project and the Missouri Hunter

January 9 - 12

PLT, WILD, & WET Facilitator Training

Camp Windermere on Lake of the Ozarks

Fee: \$75

This workshop will enable you to conduct educator workshops for Project Learning Tree, Project WILD & Project WET.

Registration fee includes meals, lodging and program materials.
Contact: Bruce Palmer, MDC, 573/751-4115, x 3113.

January 25 - 26

Energy for Missouri: Today and Tomorrow

Kansas City

Fee: \$30

This course will explore current forms of energy use and projections for the changing future of energy in Missouri. The workshop includes materials for your classroom and a tour of a local power plant.

Contact: Bryan Hopkins, DNR, 800/361-4827, 573/751-3443.

February 7 - 8

Outdoor Classroom: How to....

MDC Regional Offices, West Plains, MO

7th - 5:00 to 9:00 pm

8th - 8:00 am to 5:00 pm

Fee: Credit \$128; Non-credit at a reduced rate

If you've often wished you could develop an outdoor classroom at your school but didn't know

where to begin, how to fund it, or how to design it and found the prospect of writing a grant a bit overwhelming, this workshop is for you! Information will be included on getting started, stations and habitats, layout and design and pitfalls.

Contact Regina Knauer, MDC, 417/895-6880, Melanie Carden-Jessen, MDC, 417/256-7161, Jeff Cantrell, MDC, 417/451-4158.

February 8 – 9

Used Oil Recycling Education Program

St. Louis

Fee: \$30

An opportunity to investigate and frame the issue of used oil management by collecting and summarizing primary data. Route 66 State Park and the history of Times Beach will provide the main venue for this workshop.

Contact: Jim Lubbers, DNR, 800/361-4827, 573/751-3443.

February 12

Global Warming: The Greenhouse Effect

St. Louis Zoo Science Seminar
7:30 - 9:00 pm

Evidence continues to grow that the atmosphere of the earth is warming and that the warming trend is being caused by human activity. The seminar will give a quantitative explanation of the so-called greenhouse effect and

will discuss the global pollution of the atmosphere.
Contact: 314/768-5466 or 314/533-8083.

February 20

Project WILD Training

Interface A

Fee: \$20

Project WILD is a supplementary environmental education program for educators of grades K-12. Emphasizing total environmental awareness and wildlife, the workshop offers exciting interdisciplinary teaching ideas. Participants receive activity guides containing over 150 activities.
Contact: Bruce Palmer, MDC, 573/751-4115, x 3113, Jean Mayer, MDC, 417/895-6880, x 1036.



No mOre Trash

Missouri's first statewide anti-litter campaign is underway! The goal is to raise awareness of what we can do about litter and, ultimately, to make Missouri a litter-free state. Missourians of all ages can help make the dream come true.

Governor Holden launched the effort, which was funded initially by the Departments of Conservation and Transportation. To help spread the word in a grassroots way, he convened an anti-litter advisory board composed of members, including government, private and non-profit organizations. They'll work to spark the litter-free dream in the minds of friends, neighbors, colleagues and customers.

A website, www.nomoretrash.org, is the place to go to learn how individuals, schools and communities can get involved in spreading the "No MOre Trash!" message. Some of the projects particularly aimed at Missouri's youth include a video ad contest for 16-22 year olds. Winning videos will be picked quarterly and awarded \$200. See the first award winners and learn more about the contest on the website.

Support materials, such as signs and rubber stamps with the logo, are also available there. Teachers and group leaders can also receive award of excellence certificates to provide to students who have done litter awareness efforts, such as getting friends and family to sign litter-free living pledges, creating posters, writing essays, or hosting a litter-free event at school.



CONSERVATION CURRICULUM



Last Year in Review

For those of you who were not subscribers to *The Resource* last year or who may need reminding of the wealth of information in those issues, here is a recap of their contents. If you would like to receive copies of any of these issues contact Barb Byrne at 573/751-4115 x3287, byrneb@mdc.state.mo.us

Myths & Mysteries - October 2001: Articles describing various ways plants make our life possible, debunking myths regarding graveyards, swamps and caves, and extolling the virtues of spiders, snakes and owls.

Energy - December 2001: Ideas for teaching students the concepts of how energy exists naturally in our world, basic forms of energy and their definitions, renewable energy sources, and ideas for using your school building as an energy learning lab.

Agriculture and Private Lands - February 2002 : A focus on some non-traditional aspects of agriculture – fish farming, agroforestry, a synopsis of programs offered by Conservation's Private Land Services, and how agriculture impacts all of us.

Connecting Schools and Communities - April 2002: Tips on planning field trips with a purpose, incorporating service learning in the classroom, and finding valuable education resources close to home.

Conservation Careers

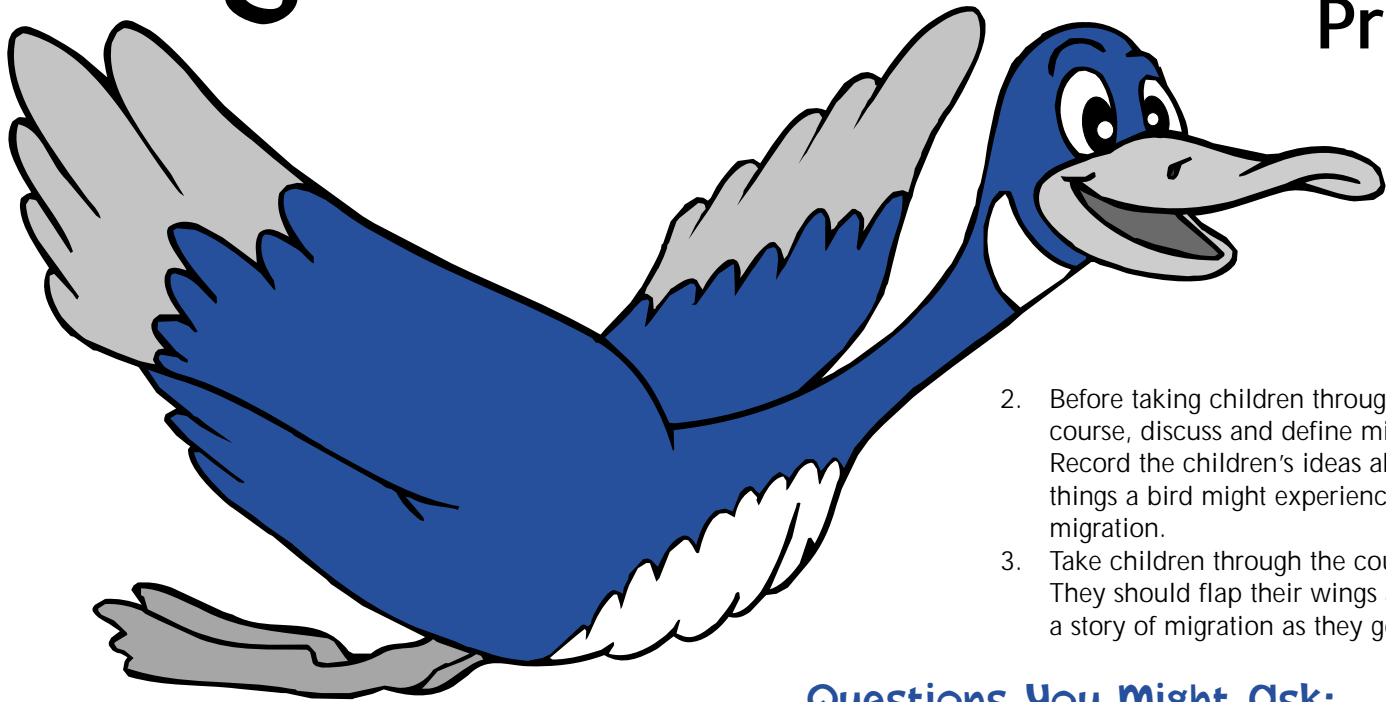
Naturalist

A naturalist is one of many careers in conservation education. Naturalists conduct interpretive programs including hikes, classroom activities and public presentations with a focus on natural resources and conservation. Many naturalists work at nature centers or state parks. They develop interpretive signage for trails, design exhibits, conduct programs for school groups, train volunteers and help the general public learn about the natural features of the site. Their work involves doing research, preparing informational materials, working with teachers and community members to prepare programs, writing news articles and developing visual aids. Working with props ranging from bird feathers and bones to turtles and tree pods, naturalists help people of all ages learn about natural resources, the environment and how people can be good stewards of the earth.

Naturalists with the Missouri Department of Conservation have graduated from an accredited college or university with a Bachelor's Degree in a Science or Wildlife area and have some interpretation or teaching experience.

Migration Scene

PreK-2



From: *Conservation Seeds*,
Missouri Department of Conservation

Did You Know?

The seasonal movement of birds and other animals is called migration. Migration may be triggered by reduced hours of sunlight, a food shortage or colder temperatures. There are many theories as to how birds find their way. Some ornithologists believe some birds follow mountain ranges, coastlines or rivers. Birds flying over the ocean are thought to follow the stars or angle of the sun. This activity will introduce the concept of migration to children.

You'll Need:

Equipment for a course, such as balance beam, climber, carpet squares, mats, streamers, stuffed animals, etc.

What To Do:

1. Set up a course using any materials at hand. Keep in mind various migration scenes the course could represent, such as balance beam "river," climber "mountain," streamers hung for "rain," carpet squares representing "food," large boxes for "buildings," stuffed animal "predators," etc.

2. Before taking children through the course, discuss and define migration. Record the children's ideas about things a bird might experience during migration.
3. Take children through the course. They should flap their wings as you tell a story of migration as they go.

Questions You Might Ask:

- Why do you think some birds migrate and others don't?
- How do you think birds know where to go in the winter?
- What dangers must birds look out for?
- How do birds know where it is safe to rest and find food?

Supplementary Activities:

Manipulative – During self-selected activity time, encourage children to sort the birds from the Missouri Department of Conservation's *Missouri Game Birds* and *Woodland Songbirds* posters or animal cards into those that fly south for the winter and those that don't.

Outside – Observe birds migrating.

Story – Read *Goodbye Geese*. (Nancy White Carlstrom. New York: Scholastic Inc., 1991.) A young child asks his parent about the arrival of winter and migrating geese.

3-4

CA - 6
FA - 1
SC - 3, 4, 7

Play-dough, tooth picks, miscellaneous crafts, e.g. plastic eyes, glitter, popsicle sticks, construction paper, pipe cleaners, straws, cotton balls, Q-tips, any other materials that your imagination can come up with.

Discuss adaptations of animals that are well-known to them. How does a coyote “make a living?” Its acute senses help to find food, e.g. good eyesight, hearing, and sense of smell. It has legs made to help it run fast. It has sharp teeth to capture and devour its prey. For older students, discuss how adaptations are important for an animal to fill its niche.

1. Divide into small groups of 4 or less.
2. Give each group an animal description and tell them to construct their animal based on the description.
3. Encourage students not to make a "real" animal, e.g. bat, woodpecker, bear, wolf, etc. Rather have each group construct a "new" animal and invent a name for it.

After all groups have finished their animals, have a spokesperson from each group:

- Show and give the name of the animal they constructed.
- Read the animal's description.
- Describe the animal's adaptations, i.e., Why did they make the animal the way they did?

Description Cards

1. You are an animal that eats flying insects.
2. You are an animal that captures and eats a very fast prey.
3. You are an animal that moves slowly and eats other animals which live in the forest.
4. You are an animal that eats creatures that live in the soil.
5. You are an animal that eats creatures that are active at night.
6. You are an animal that eats creatures that live in dead trees.
7. You are an animal that eats seeds that grow from large trees.
8. You are an animal that eats plants, but moves very slowly and can be easily attacked by other creatures.

Aquatic Descriptions

1. You are an animal that lives along the edge of a swamp and eats flying insects.
2. You are an animal that lives on the surface of the water and its prey are small animals.
3. You are an animal that dives down into the water to capture fish to eat.
4. You are an animal that lives in and around aquatic plants and attacks/eats a very fast prey.
5. You are an animal that eats aquatic plants and digs into the ground for protection.
6. You are an animal that lives in the water, and you attach yourself to other animals sucking their fluids.
7. You are an animal that eats fish and other animals that live in the shallow parts of a pond.
8. You are an animal that eats phytoplankton and zooplankton.

Wrap up:

1. Discuss what adaptations the constructed animals have that reflect those found in real life animals.
2. How do these adaptations help the animals survive in their particular habitats?

Winter Bird Feeding

Objectives

Students will 1) describe the role humans play in helping birds survive the winter; 2) identify species of birds that winter in Missouri; 3) identify seeds that provide food for wintering birds; 4) observe how different species of birds interact; 5) develop journal writing skills.

Materials

- Bird Feeder
- Seeds
- Recyclable Disposable cups or bowls
- Missouri Department of Conservation *Winter Birds Identification* brochure (Publication E431)
- Individual Journals

Preparation

1. Install a bird feeder. See copy page for plans students can use to build a feeder.
2. Discuss the benefits of feeding birds that stay in Missouri for the winter.
3. Collect and show pictures of Missouri's winter birds.
4. Discuss the different types of seeds and winter food available.
5. Have students decide which seeds would be the best to use in your homemade seed mix. Use the Missouri Department of Conservation *Backyard Bird Feeding* chart as a guide. (Publication E450)
6. Discuss how to do journal entries.

Sample Journal Entry

December 20, 9:30 am, cloudy, 47°F, slight northerly breeze

Two birds came to the feeder together. One was brilliant red, but the other was a little darker, almost brownish, and not nearly as pretty. Both had a crest of feathers on their head and heavy red bills. They fed on the sunflowers seeds that had spilled out of the feeder on to the ground. Soon a large bright blue bird arrived. It was twice as big as the red birds. It landed on the feeder and made a mess throwing seeds all over. The red birds seemed startled by its arrival and left shortly thereafter.

Procedure

1. Place the birdfeeder in a location that can be easily seen from the classroom window.
2. Divide the class into small groups of 3-4.
3. Have each group prepare some seed mix based on what the class decided in the preparation phase.
4. Have a student from each group pour their mix into the feeder.
5. Post the bird identification chart near the window that overlooks the feeder.
6. Whenever a bird (or other animal) comes to feed, have students write what they are seeing in their journals. – Is it one bird or several? What does it look like? How big is it? How long does the bird stay? What is the birds' behavior at the feeder? Are different types of birds competing with each other? If another animal tries to feed, what kind of animal is it? Was the animal successful in getting food from the feeder? How do the birds react to other animals at the feeder?
7. Have students share what they have written in their journals.
8. Use the shared entries as a point for further discussion.

Extensions

Students can make Bird Wreaths, as described in *Outside In*, to use in addition to (or in place of) the bird feeder. If using the wreaths and the bird feeder, students can journal what they observe at both sites and then compare the differences based on the different types of food. If using only the wreaths, discuss the types of food that the students are putting on the wreaths and track which species of bird prefer which type of food.

Supplementary Activities

Art – Have students decorate the covers of their journals. They can use colored markers to design, sketch or draw nature-related pictures or they can make a collage on the cover by cutting out pictures of winter scenes, birds, etc. and pasting them on.



Language Arts – Have students choose one species of bird they have observed and write a paragraph or short paper describing what they have learned about that bird's habits.

Math – Have students keep track of or compute such things as: How many ounces/pounds of seed did they put in the feeder to start and how much do they add each week? What's the total amount of food eaten all winter? Track the total number of each species of bird for a week and then compute the percentage of each species that ate at the feeder for the week. Track the time of day a certain species comes to feed and compute the elapsed time between feedings for that species. (Class can be divided into groups and each group could track a different species.)

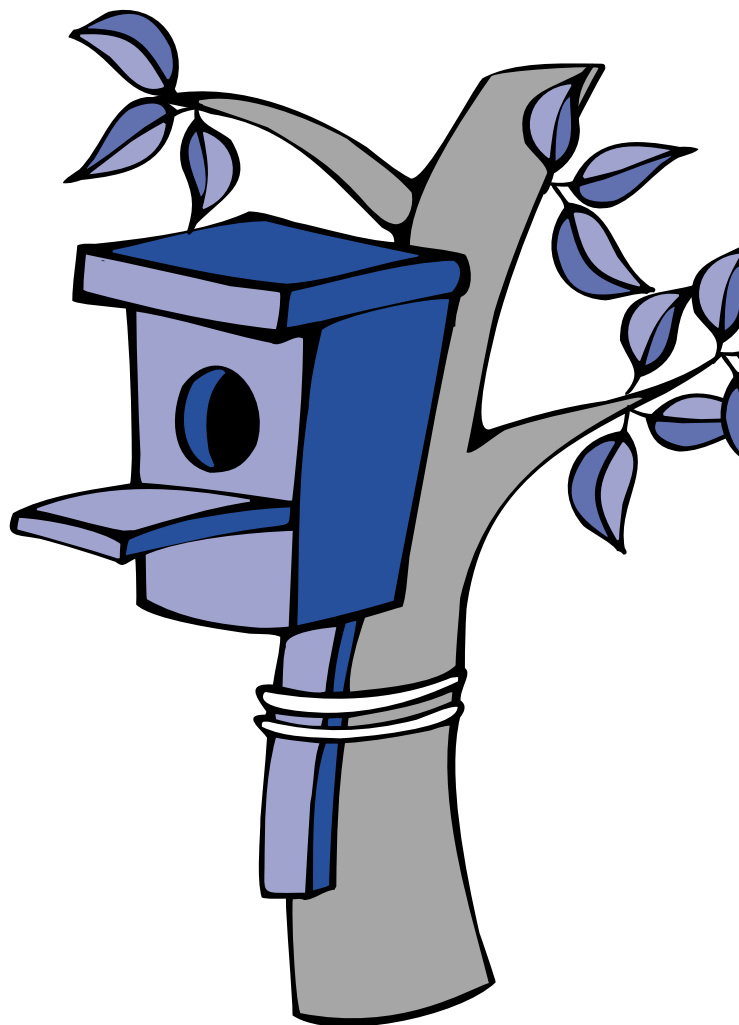
Installation: The feeder can be mounted on a post as diagrammed or hung, using wire from a coat hanger. Place it in a site where you can enjoy watching your customers from the comfort of your home. Preferably, the feeder should be near bushes or trees to provide the birds with avenues of approach and retreat. You can attempt to discourage competing squirrels by installing the feeder on a 6-foot-high post or pipe, at least 20 feet away from points from which they can jump. Then fasten an inverted cone of sheet metal at least 18 inches in diameter around the post just beneath the feeder.

Maintenance: Flour will accumulate on the floor of the feeder and, when combined with moisture, forms a hard paste. This must be scraped off so that the seed feeds through properly and the drain holes remain functional.

How to Build a Bird Feeder

From: *Woodworking for Wildlife*, Missouri Department of Conservation

Construction: The Plexiglas sides show the level of the feed. However, Masonite can be used instead. Either material can be attached with screws or nails directly to the edges of the ends, or you can saw a kerf 1/4 inch from the front edge of the ends, and slide Plexiglas, Masonite, or glass panels into the groove. A removable panel of this type permits easier cleaning. The 6 1/2 inch-wide Plexiglas should be installed so that its top edge meets the roof, thus providing the critical 1-inch clearance at the bottom for proper seed flow.

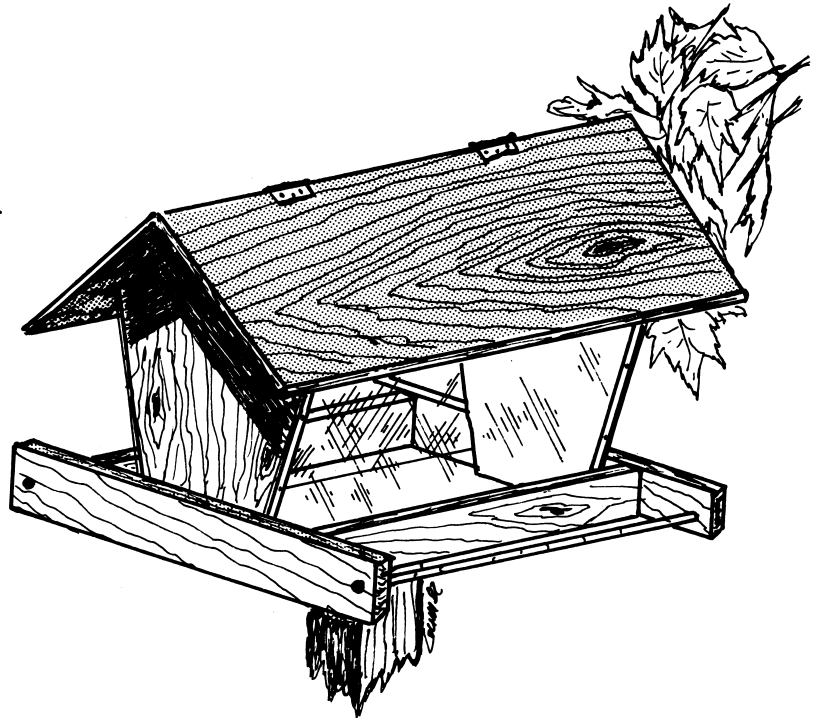


HOW TO BUILD A BIRD FEEDER

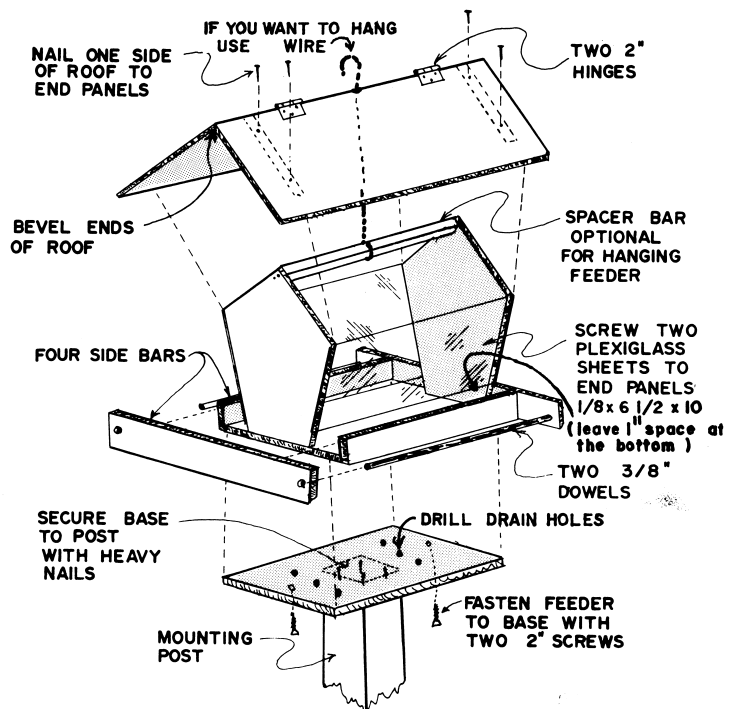
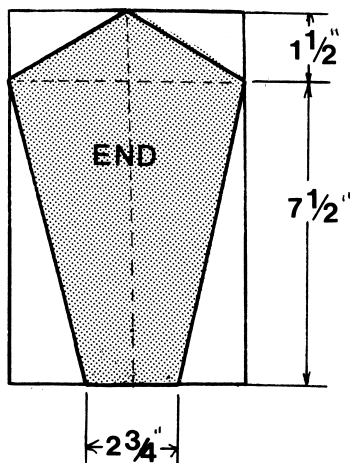
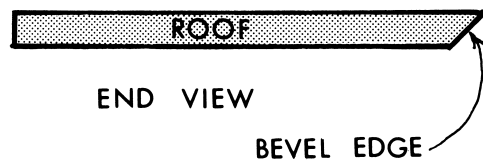
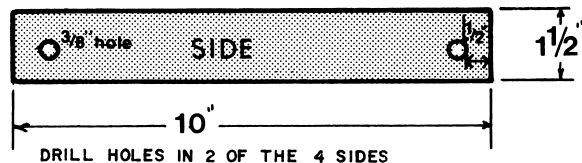
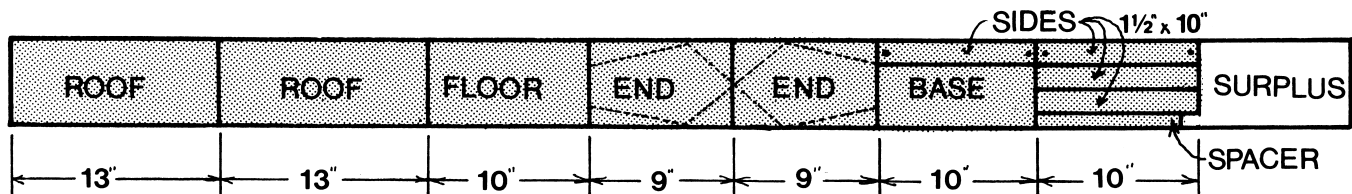
Drawings
by Steve Gum



Missouri Department of Conservation



ALL PARTS FROM A SINGLE 1" x 6" BOARD 7' LONG



Steve Gum

9-12 Birds of Prey

From: *Project WILD*

Objectives

Students will: 1) interpret a graph of animal populations, noting changes over time; 2) hypothesize the relationship between temperature, ground squirrel behavior and falcon populations; 3) describe the importance of interdependence to the functioning of an ecosystem.

Standards

| | |
|------------------|-----------------|
| Goal 1 – 2, 5, 6 | CA – 1, 4, 5, 6 |
| Goal 2 – 3 | MA – 3, 6 |
| Goal 3 – 5 | SC – 3, 4, 7, 8 |
| Goal 4 – 1 | |

Method

Students interpret data on wildlife populations, generate hypotheses related to the data and research potential explanations.

Materials

Graphs A-E enlarged for classroom use; Optional: photographs of predator and prey species.

Background

In the Birds of Prey Natural Area in southwestern Idaho, a large number of prairie falcons nest in late spring and early summer each year. The falcons mainly live off a large population of Townsend ground squirrels that live in the surrounding flatlands. Throughout the breeding season, the population of falcons increases as more and more birds move into the area to nest, until all available nesting sites are taken. Since the Townsend ground squirrels serve as the food base for the falcons, continued activity and availability of this prey base is crucial for the support of the nesting falcons. As the summer progresses, the daytime temperatures in the area increase to a point (around July 4th) where it is too hot for the ground squirrels, and they go underground and undergo a form of summer sleep called "aestivation" or summer hibernation. Without available prey, the falcons and their new offspring must either leave or die. Within a day of the ground squirrels' aestivation, nearly all falcons capable of flight move out of the area in search of other food (other ground squirrel species and rodents). Most move to higher, cooler elevations where other species of ground squirrels (such as Columbian ground squirrels) remain active. This sudden seeming "loss" of

falcons from the Birds of Prey area is directly tied to the important environmental factor of temperature.

The major purpose of this activity is for students to recognize that life forms and environmental factors interact in natural ecosystems to keep wildlife populations in long-term dynamic equilibrium with each other and their habitats.

Procedure

1. Set the stage by giving students the following background information:

The Birds of Prey Natural Area in Idaho hosts the largest concentration of nesting prairie falcons in the world each spring and summer. The birds nest along the cliffs above the Snake River and use the huge Townsend ground squirrel population for food. This prey species lives on the flat land above the canyon. Each year, the populations of these two species change from April through July.

2. Show the students Graph A. Have them look at the graph to see what happens to the populations of predator and prey, and answer the following questions:
 - What do you observe happening?
 - What do you notice about the Townsend ground squirrel population in April, May and June?
 - What do you notice about the ground squirrel population in July?
 - What do you think caused this drop in population? What might have happened to the squirrels?
 - What do you notice about the falcon population in April and May?
 - What do you notice happening to the falcon population in July? What do you think caused this population decline?
 - What might have caused the change?
 - How do these populations seem to be related?

Ask the students to speculate, offer hypotheses and develop questions to assist with finding a solution to this dilemma.

3. Show the students Graphs B, C, D, and E. Using the information provided on these graphs, encourage students to discuss their ideas and hypotheses.



4. Ask the students to share those ideas that seem to be most reasonable given the information presented in the graphs.
5. Summarize the activity by:
Closed inquiry approach – Review the sequence of events. Discuss the role of temperature in triggering aestivation. Ask the students to predict what the falcons might do if their food source “disappeared.” Where might they find the falcons after they leave the area? Where would they go to obtain food? What kind of prey species might they use? Have the students suggest other physical factors that influence or limit wildlife activity. Have the students also propose some ways these same factors influence or limit human activity.
 OR
Open inquiry approach – Do not provide the above information, but allow student teams to research information on the squirrels and falcons.



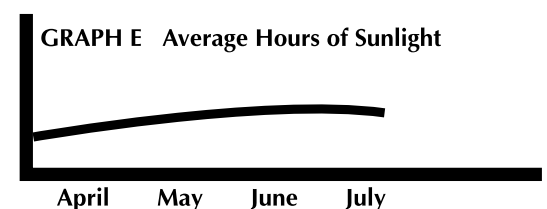
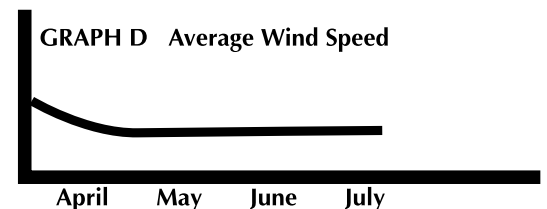
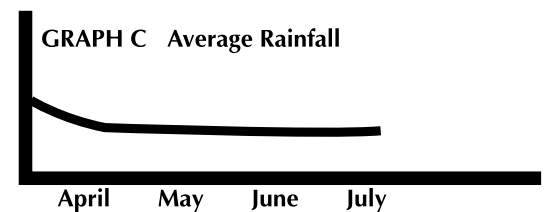
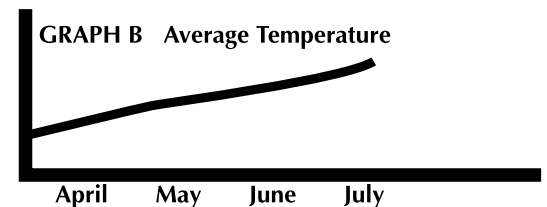
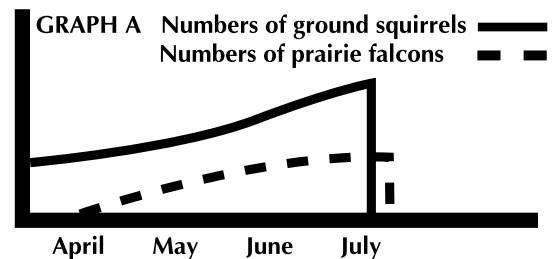
6. Extend the discussion to the concept of interdependence in ecological systems. What was interdependent in this situation? Encourage the students to think of other examples of interdependence. Can they think of any ecosystems that are not composed of interdependent parts? Generalize that all ecosystems are made up of interdependent parts.

Extensions

1. The prey ordinarily used by the falcons at the natural area – the Townsend ground squirrel – is distributed throughout much of the plains area above the river, which is also potentially good agricultural land. Given this information, the activity could be extended to an investigation into competitive uses for the land occupied by the prey base, the legislation behind the establishment of the natural area and/or related controversies.
2. Investigate the process by which such natural areas are set aside, the agencies involved and related issues.
3. Describe the usefulness of mathematical data in interpreting relationships between organisms in ecosystems, using the Birds of Prey Natural Area as an example.

Evaluation

1. Using Graph A as a reference, describe for each month between April and July:
 - a. relative population levels of squirrels and falcons
 - b. the behavior of squirrels and falcons
 - c. the role of temperature on a and b above
2. Explain the importance of interdependence to an ecosystem.



Winter Watch • • • •

DECEMBER

- Barred Owls are courting; listen for "Who cooks for you? Who cooks for you all?"
- Bald Eagles arrive in Missouri.
- Evening grosbeaks eat sunflower seeds at feeders.
- The leaves of Christmas ferns are green on wooded slopes.
- Squirrels gather in nests to conserve energy.
- Orion, Taurus and other winter constellations are visible.

JANUARY

- White-tailed deer bucks begin to lose their antlers.
- Snow fleas are visible in sunny wooded areas
- Ozark witch hazel begins blooming after a few days of warm weather.
- Adult winter stoneflies may be seen along streams.
- Snowy owls are seen here when food is scarce in the Arctic.
- Eastern moles are active in deep tunnels underground.

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Mission Statement:

The Resource is published in October, December, February and April by the Office of Environmental Education. Its purpose is to provide current information on conservation and environmental education resources and events, professional development opportunities and suggestions for integrating environmental subjects into teaching.

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